California Environmental Protection Agency
AIR RESOURCES BOARD

AIR QUALITY SURVEILLANCE BRANCH

SMART HEATER FIELD INSTALLATION PROCEDURE

FOR

MET-ONE INSTRUMENTS
BETA ATTENUATION MASS MONITOR
(BAM-1020)

First Edition

MONITORING AND LABORATORY DIVISION

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MODEL 1020**

1.0 GENERAL INFORMATION

1.1 Introduction:

The purpose of this "Smart Heater Field Installation Procedure" is to document the Met One Instruments Smart Heater (BX-827) upgrade procedures as performed by the Air Quality Surveillance Branch (AQSB) of the California Air Resources Board. The goal of this SOP is two fold; to formalize AQSB BAM-1020 Smart Heater upgrade procedures and to describe supplemental information/modifications to the Met One Instrument's BAM-1020 BX-827 Field Upgrade Kit Assembly Procedure. Met One's BX-827 Field Upgrade Kit Assembly Procedure contains a significant source of information to perform the Smart Heater upgrade procedure and therefore AQSB highly recommends a thorough review of that document.

1.2 Principle of Operation:

Following the initial deployment of the Met One BAM-1020 monitors into the ARB's continuous mass monitoring network, two noticeable issues surfaced; inlet flow/leak check failures and higher regression slope values when compared to PM2.5 FRM filter data (BAM-1020 positive bias). These issues may be related and caused by ambient moisture.

The Smart Heater resembles a small aluminum can, rated at 200 Watts and is installed in lieu of the 30 Watt heater tape. The Smart Heater requires specific firmware and hardware to operate properly. A heat tape can easily replace a Smart Heater, but a Smart heater cannot simply replace a heat tape without additional parts and extensive modifications. Unlike the inlet heat tape kit, the Smart Heater can be controlled using the monitor's inside %RH and/or temperature. These set points can be adjusted through the BAM-1020 front panel soft keys.

The BX-827 Smart Heater field upgrade kit was purchased to standardize all ARB owned BAM-1020 monitors. BAM-1020 monitors purchased with the Smart Heater option have shown to significantly improve operation and maintenance issues. FRM comparison improvements with Smart Heater equipped BAM-1020 monitors have yet to be determined.

1.3 Safety Precautions:

Only properly trained personnel should perform the BX-827 Smart Heater field upgrade. As with all monitoring equipment, precautions should be taken when working around electricity, power tools and above ground elevations.

The BAM-1020 ^{14}C radioactive source should never be dismantled, removed

or tampered with.

The BAM-1020 monitor should be turned off and the power cord disconnected during the upgrade installation. Disconnecting the power cord will reduce the possibility of permanent damage to life and equipment.

2.0 INSTALLATION PROCEDURE

The BX-827 Smart Heater upgrade kit contains two EPROM versions. Prior to the upgrade procedure, determine which version of firmware (EPROM part number) is currently installed in the monitor. The installed firmware version will be displayed in the main user screen. If the firmware version has a –02 as part of the number, then replace with EPROM 3236-2 R2.55. If installed version does not have an –02, then upgrade with EPROM 3236 V2.55.

The BX-827 Smart Heater field upgrade installation procedure has been separated into the following thirteen (13) areas. Each area is described in further detail.

2.1) List of tools.
2.2) List of BX-827 Smart Heater kit components.
2.3) Physical Inspection.
2.4) Replace circuit board.
2.5) Drilling two holes for wiring assembly.
2.6) Attach relay harness assembly.
2.7) Attach wire harness to power supply.
2.8) Replace RH and Temp assembly.
2.9) Replace fuses.
2.10) Replace firmware.
2.11) Install voltage divider.
2.12) Configure BAM-1020 settings.
2.13) Install inlet heater.

2.1 List of Tools:

1) Drill bit (5/32” – 3/16”).
2) Drill bit to remove heat tape control box connector if required (1/8”).
3) Voltage meter (DC).
4) Philips screwdriver
5) Drill (3/8” or 1/2” chuck)
6) 9/16” and 11/16” socket (typically included in 3/8” socket driver set).
7) 5/16” (typically included in 1/4” socket driver set).
8) Channel locks or pliers.

2.2 List of BX-827 Smart Heater upgrade kit components:

1) 200 Watt BAM-1020 inlet heater
2) Circuit board
3) Harness assembly
4) Wiring harness
5) RH and Temp assembly
6) Firmware
7) Fuses (3.15 A)
8) Voltage divider
9) Tubing piece
10) Small bolt/nut hardware
11) Smart Heater
12) Smart Heater Insulator

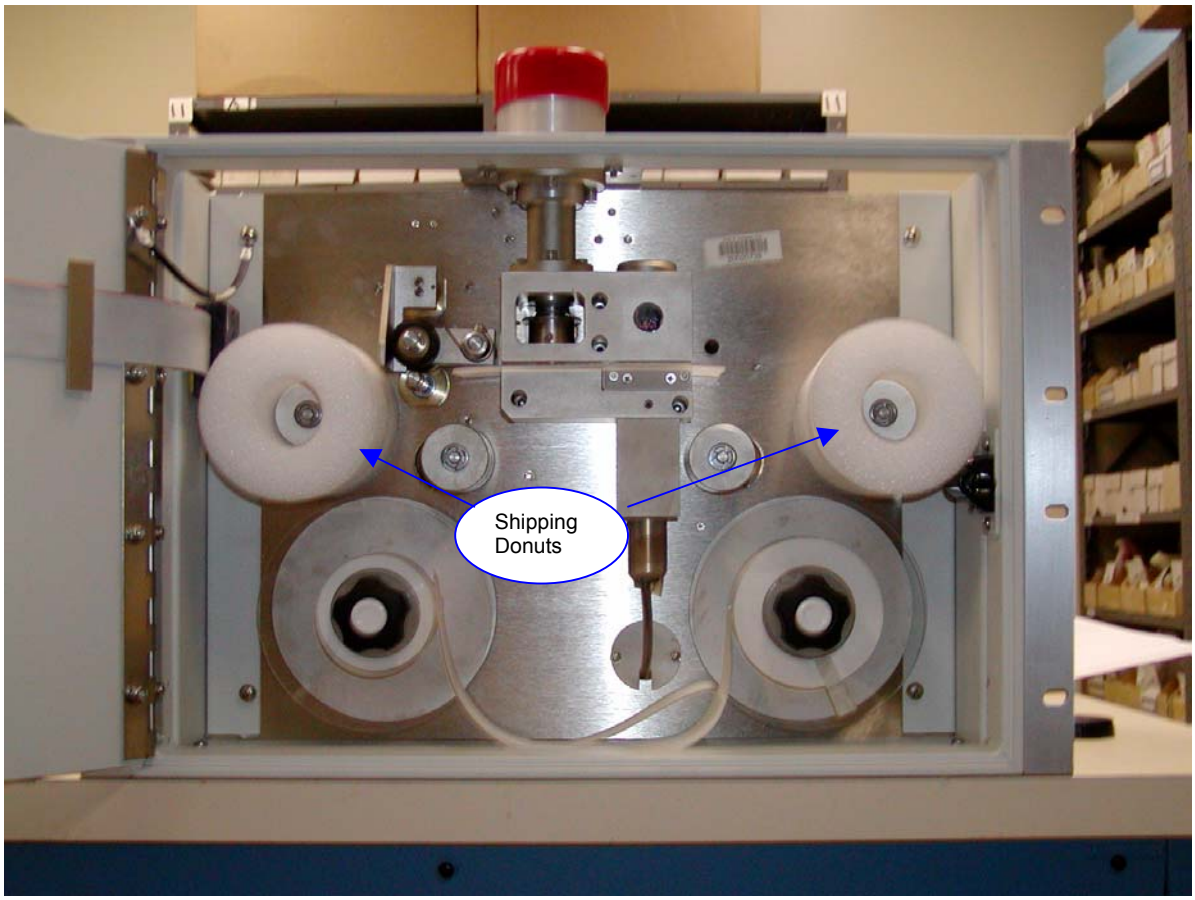
2.3 Physical Inspection:

Upon receipt of a BAM-1020, inspect upgrade kit for completeness and for shipping damage. If shortage or damage is found, immediately notify the staff involved with BAM-1020 equipment in the Operation and Support Section (OSS).

2.4 Drilling two (2) holes for wiring assembly:

1) Copy template located on sheet 9 of Met One's BX-827 Field Upgrade Kit Assembly Procedure. From the template copy, cut around perimeter on all four (4) sides.

2) With transport mechanism shipping donuts in place, turn BAM-1020 back panel upward so that monitor is resting on it's front panel (front panel lying face down).



Picture 1: BAM-1020 With Shipping Donuts

3) Looking at the bottom panel of the BAM-1020 (with face panel down) place template (cut from copy) to the upper left of the BAM-1020's bottom panel.

4) Visually inspect inside of BAM-1020 to determine if two (2) hole locations are clear for drilling (locations on template are marked as circles with plus symbol in middle).

5) With template in place, mark and drill the two (2) holes with 5/32" drill

bit (drill bit from 5/32” to 3/16 will work) and remove all metal shavings.

6) Leave the BAM-1020 in face down position to attach the relay harness assembly.

2.5 Replace circuit board:

1) Verify that BAM-1020 is powered off and unplugged from AC power.

2) Verify that foam shipping donuts are in place on the BAM-1020 end rollers. Damage to the transport mechanism can occur if the unit if it is not configured for shipping.

3) Remove the BAM-1020 top cover (10 screws)

4) Label and disconnect all wires connected to outside rear panel circuit board terminals.

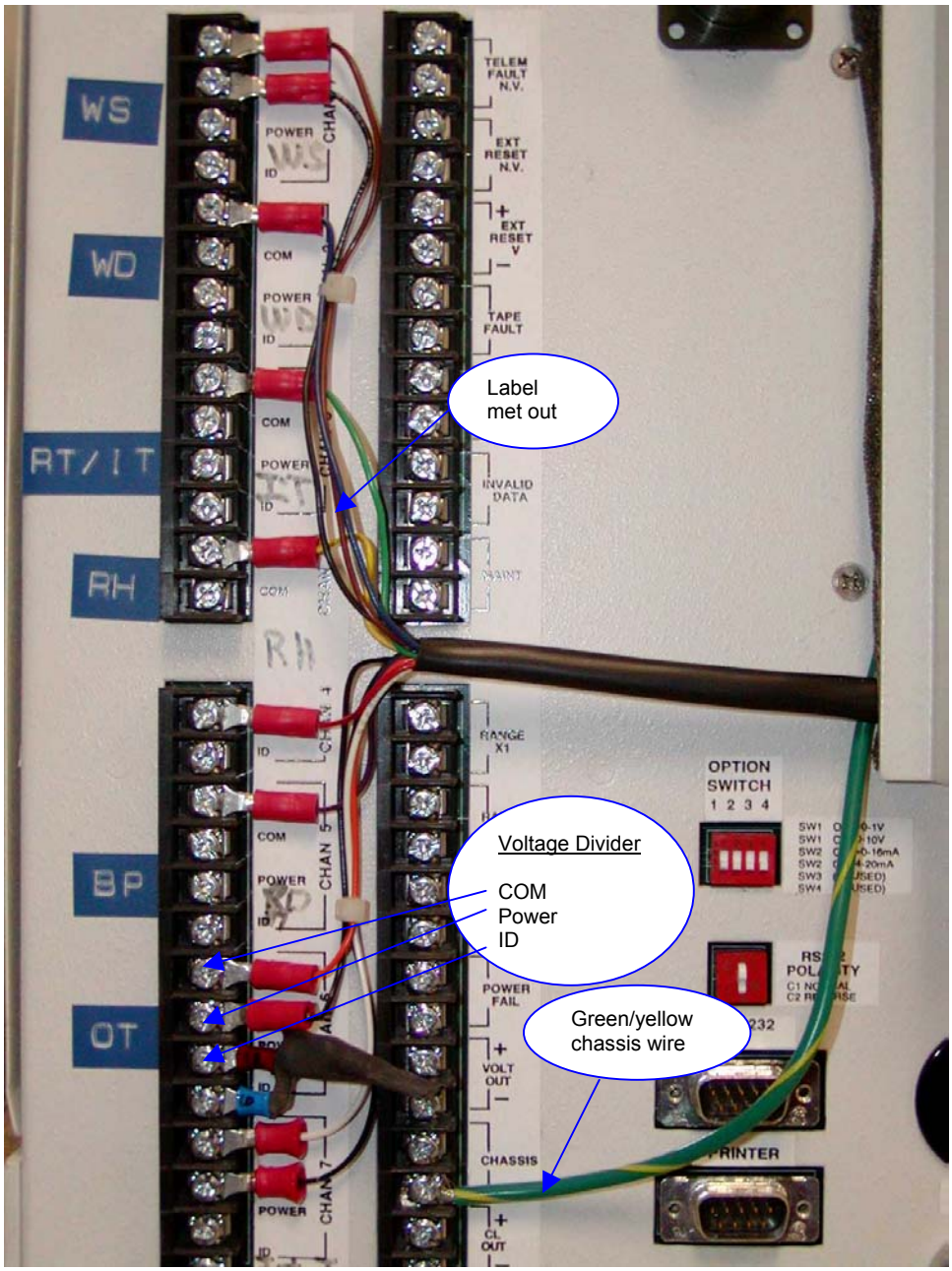
5) Mark and disconnect the two (2) circuit board ribbon cables connected to inside of circuit board.

6) Remove hex nuts (use 5/16” socket) that hold ground cable to circuit board (1) and circuit board to rear panel (8).

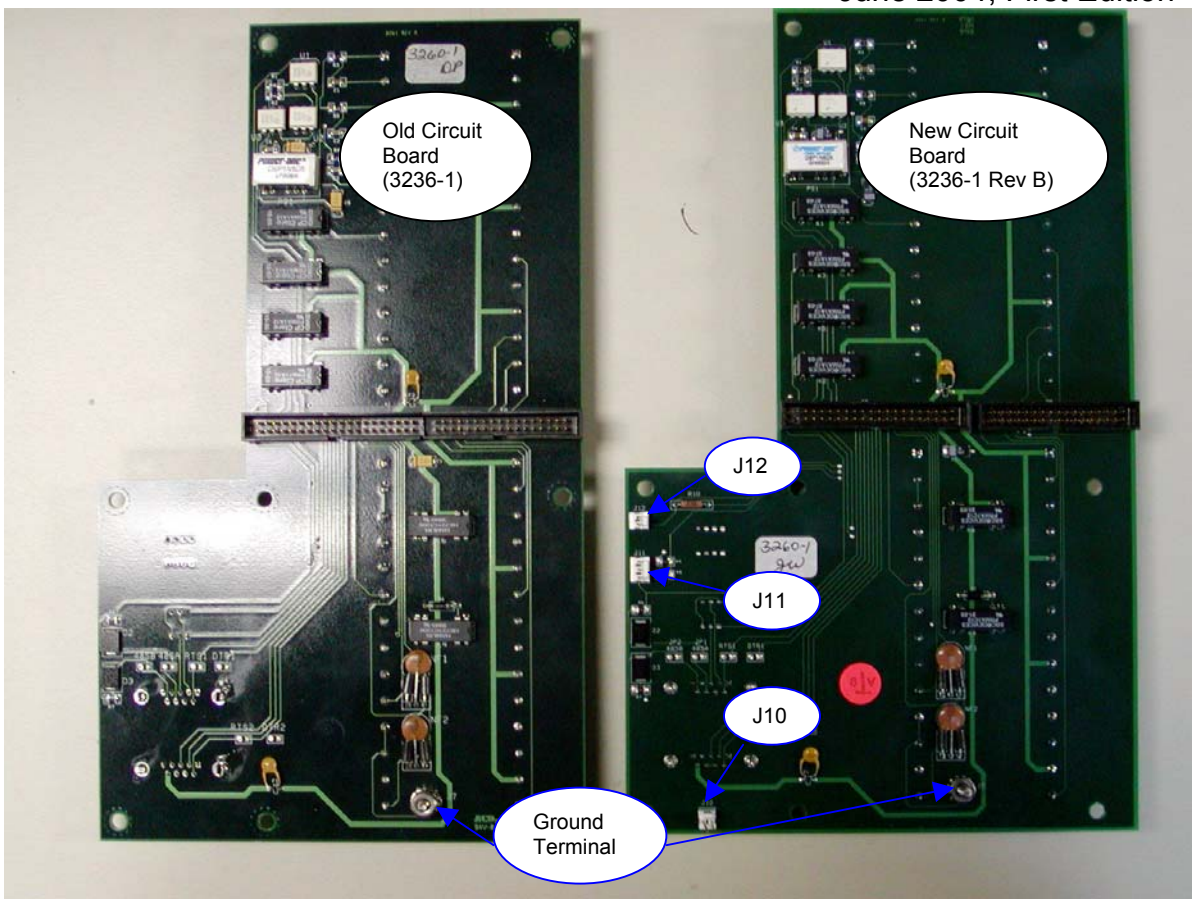
7) Install new circuit board (3260-1 Rev B) in reverse order by:

a) Installing circuit board to rear panel using original hex nuts.
b) Installing inside ground cables to circuit board with hex nut.
c) Attaching two (2) inside ribbon cables to circuit board.
d) Attaching all external wires to circuit board rear panel terminals (including green/yellow chassis ground wire).

8) The new circuit board (3260-1 Rev B) has three new jacks to connect to the power supply (J10), RH (J11) sensor and TEMP sensor (J12).



Picture 2: Rear Panel of Circuit Board (3236-1 Rev B)



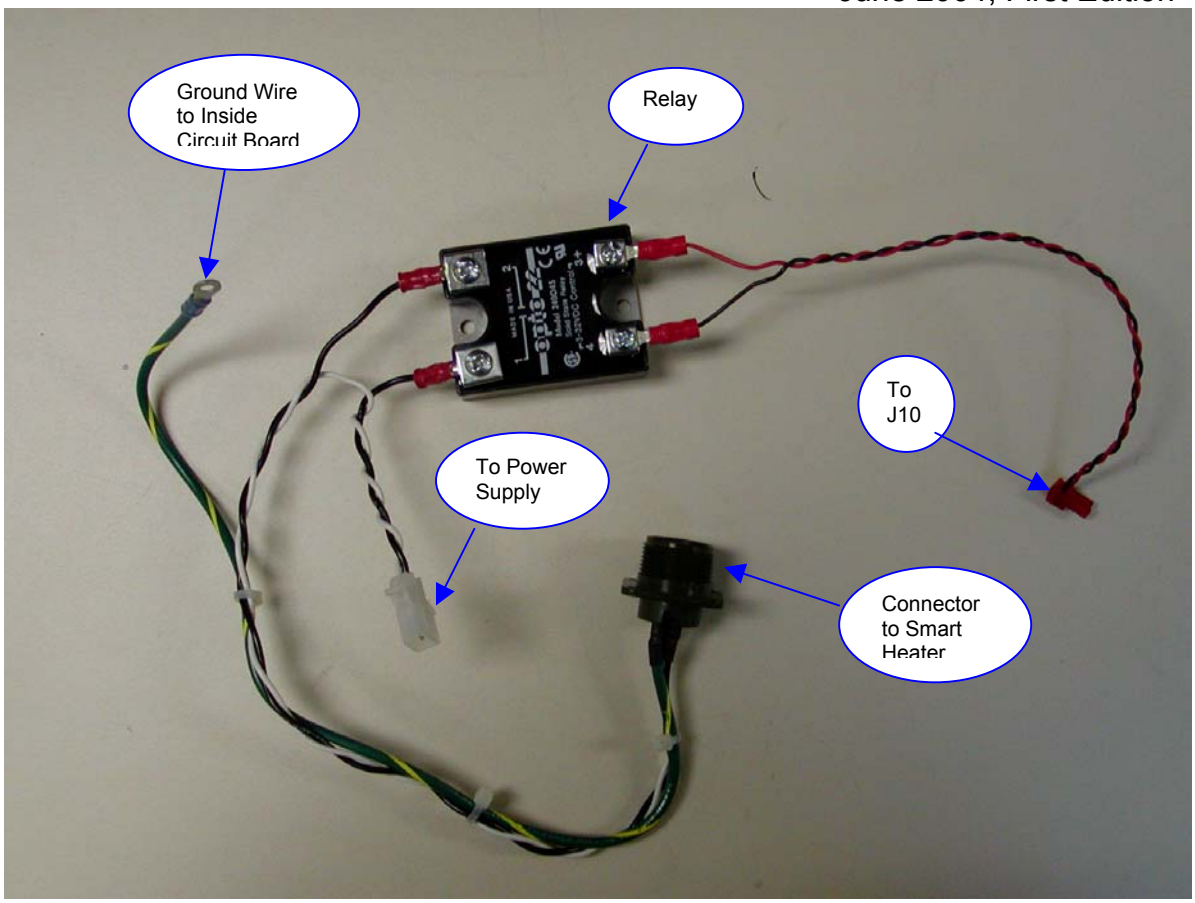
Picture 3: Old Circuit Board 3236-1 (Left), New Circuit Board 3236-1 Rev B (Right)

2.6 Attaching relay harness assembly:

1) Disconnect the feed wires of the Smart Heater connector from the relay harness assembly.

2) From the outside of the rear panel, slide the feed wires of the Smart Heater connector through the hole where the old internal RH and Temp sensor connector was removed (BX-962 connector).

3) Reconnect the Smart Heater feed wires to the relay harness assembly.



Picture 4: Relay Harness Assembly

4) Place the metal side of the relay harness assembly to the inside bottom panel of the BAM-1020 with the Smart Heater connector pointing towards the rear panel. Position the mounting holes of the relay harness assembly to the new holes drilled through bottom panel (step 2.4).

5) Slide the two (2) 8-32 x ½" screws (with washers) through the drill holes from the outside bottom panel of the BAM-1020 and through the relay harness assembly.

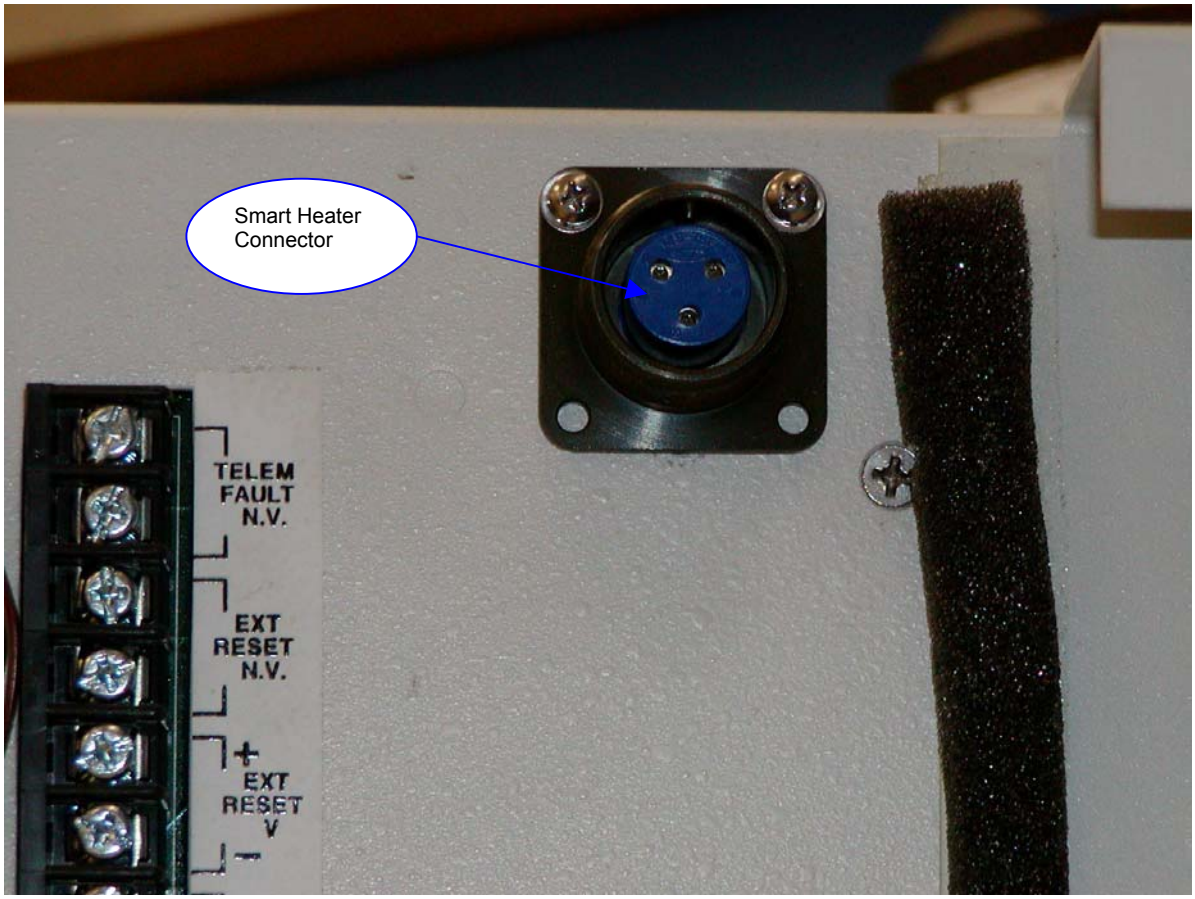
6) Using the two (2) ivory colored, cylindrical, one (1) inch long spacers as nuts, attach the relay harness assembly to the bottom panel by screwing the two (2) 8-32 x ½" screws into the ivory spacers.

7) Turn the BAM-1020 on its bottom panel (right side up or normal operating position).

8) Attach the clear plastic cover labeled "DANGER" "HIGH VOLTAGE" to

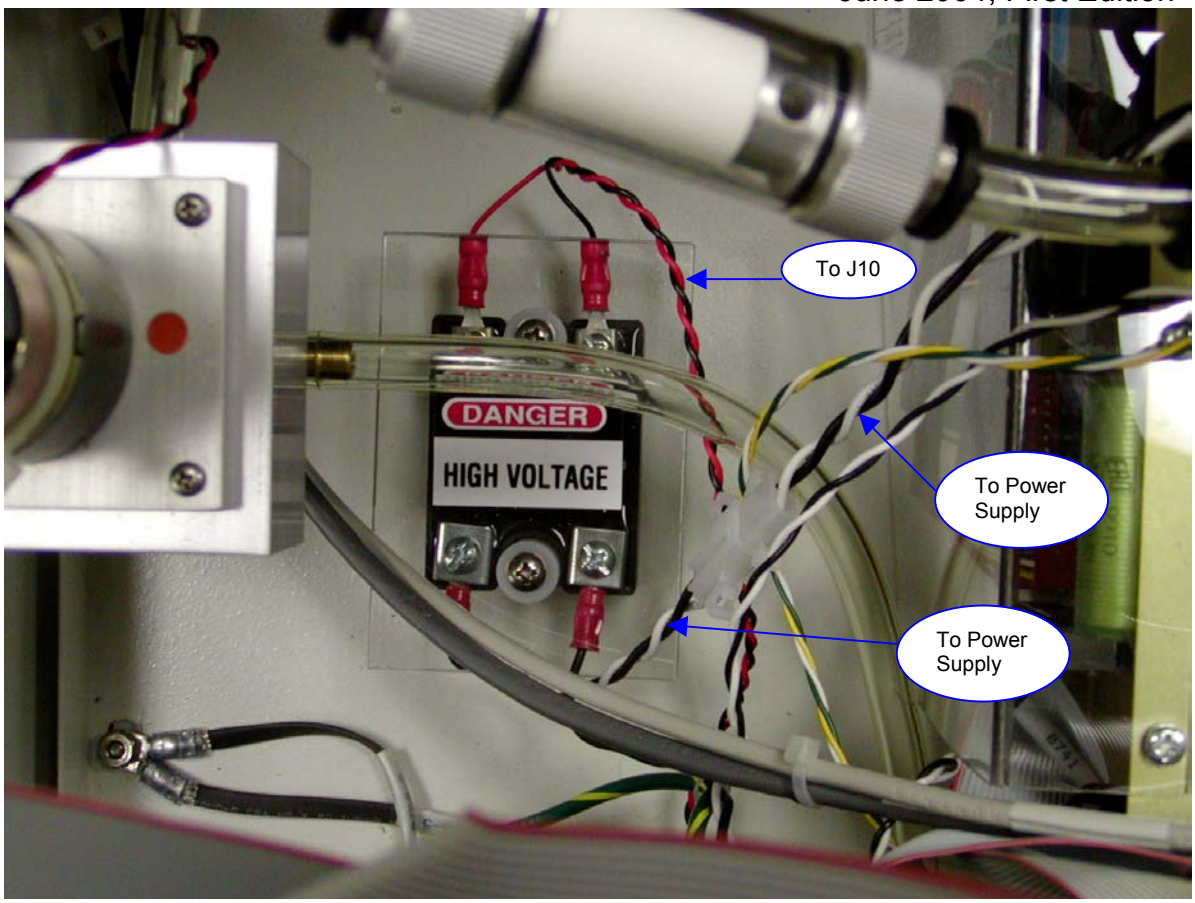
the relay harness assembly using the other two (2) 8-32 x ½" screws and washers.

9) Attach the Smart Heater connector to the outside of the rear panel using the two (2) smaller screws and nuts.



Picture 5: Rear Panel Smart Heater Connector

10) Attach the two wire female connector the new circuit connector labeled "J10".



Picture 6: Relay Harness Assembly Installed

2.7 Attach relay harness assembly to power supply:

1) Remove the BAM-1020 power supply cover (two (2) screws located on top of cover and two (2) screws located on outside lip of cover.

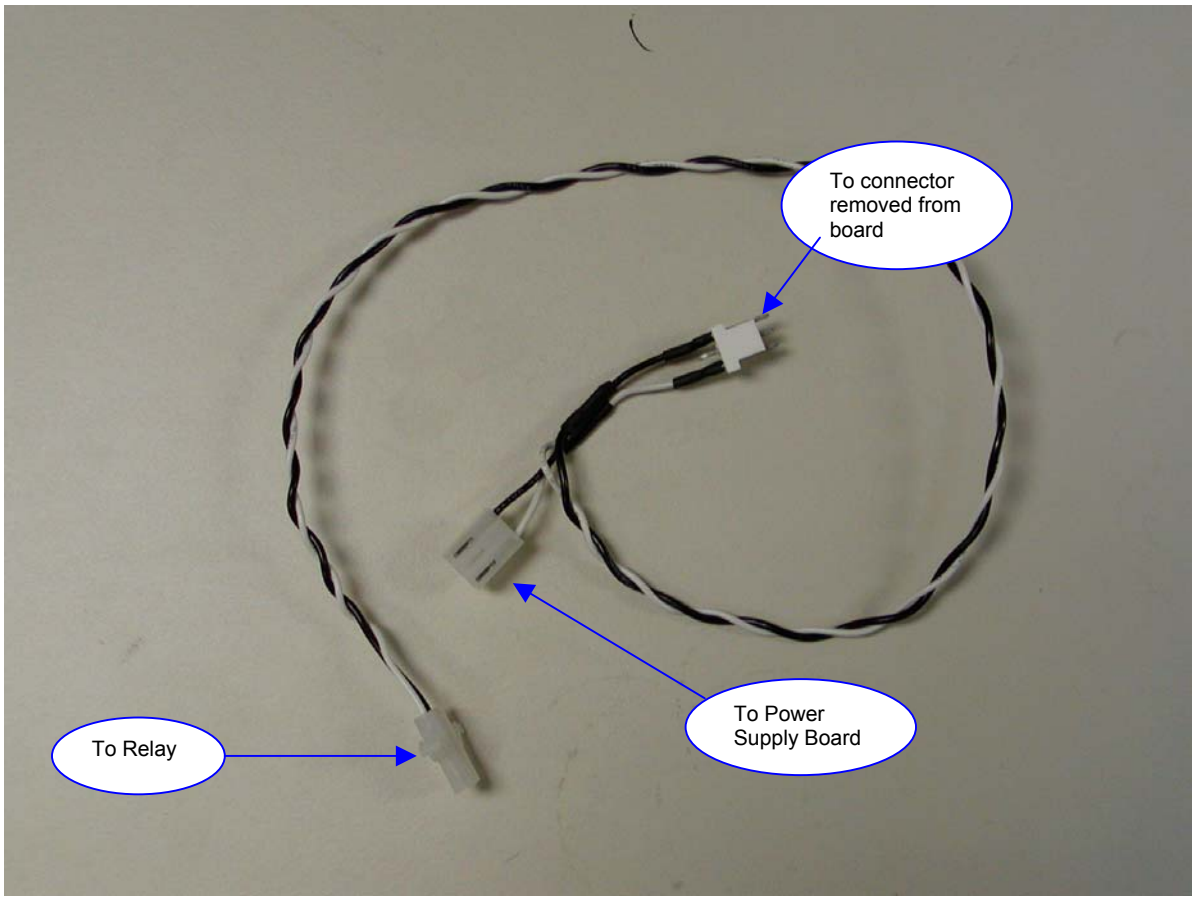
2) Disconnect the power supply connector on the rearward power supply board (a black and white wire with a white connector).

3) Plug the male connector of the new power supply wire harness to wire connector removed in the above step.

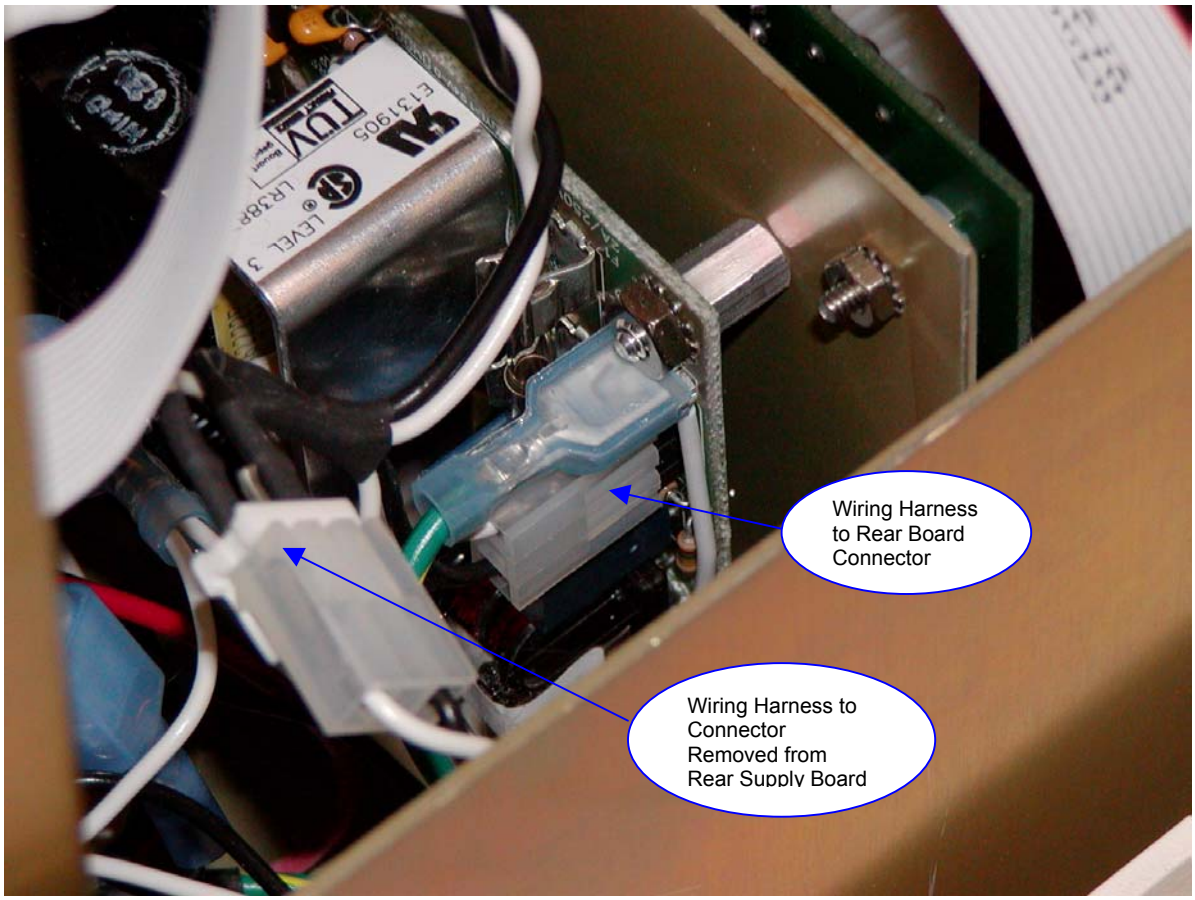
4) Plug the nearest female connector to the power supply board where the old connector was previously detached.

5) Connect to other end of the wiring harness to the relay harness assembly.

6) Replace cover on power supply.



Picture 7: Wiring Harness From Relay to Power Supply



Picture 8: Wiring Harness to Power Supply Installed

2.8 Replace RH and Temp assembly:

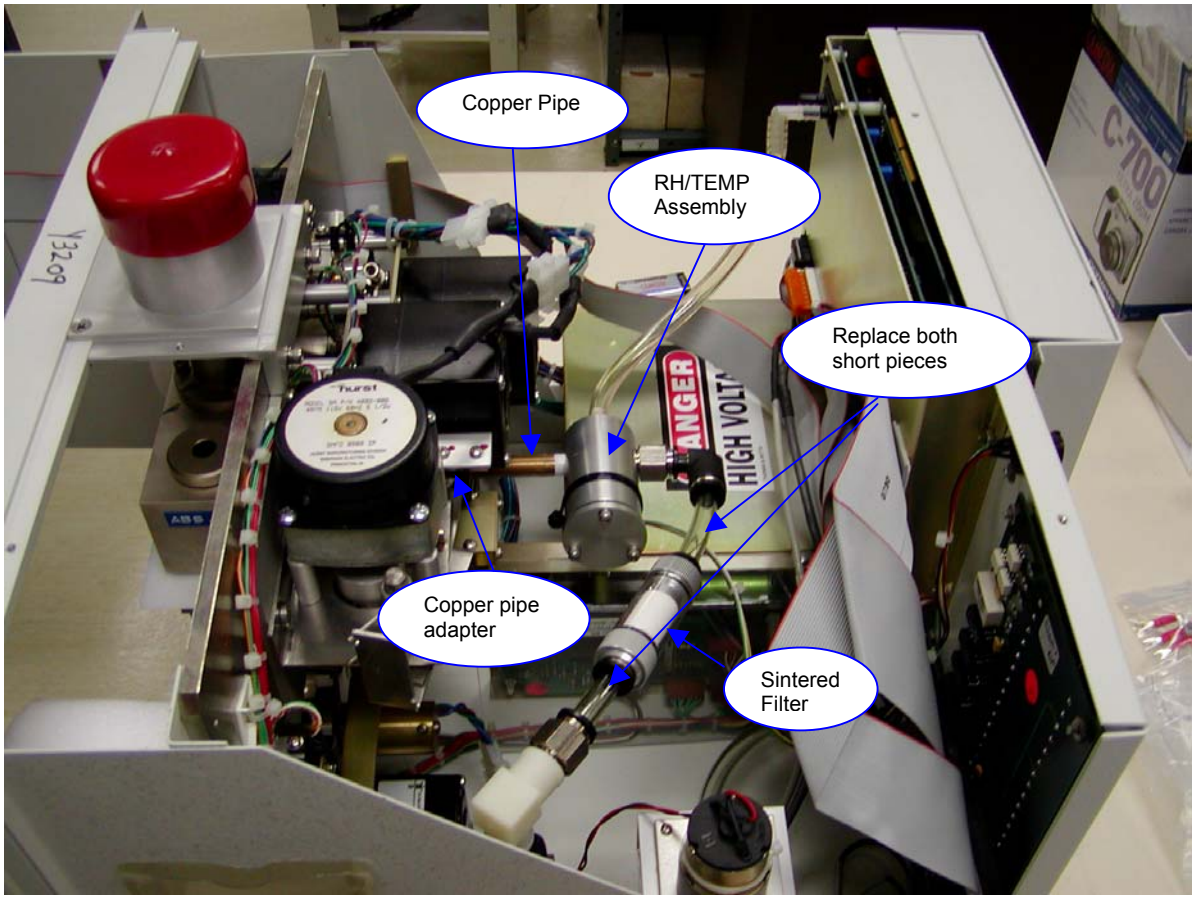
1) Remove the clear tubing/sintered filter assembly that connects to the mass flow meter and the RH/Temp assembly (quick disconnects).

2) Disconnect the pressure sensor tubing from the RH/TEMP assembly.

3) Remove the RH/Temp sensor assembly by unscrewing from the long copper pipe.

4) Unscrew the long copper pipe (using channel locks or pliers).

5) Remove copper pipe adaptor from the back of the aluminum beta block (using 9/16" socket).



Picture 9: Old RH/TEMP Assembly

6) Screw in the new supplied RH/Temp quick disconnect adapter into the back of the beta block where copper adapter was removed (using 11/16" socket).

7) Insert the new RH/Temp manifold into the quick disconnect adapter.

8) Insert the new black "Y" fitting into the new RH/Temp manifold.

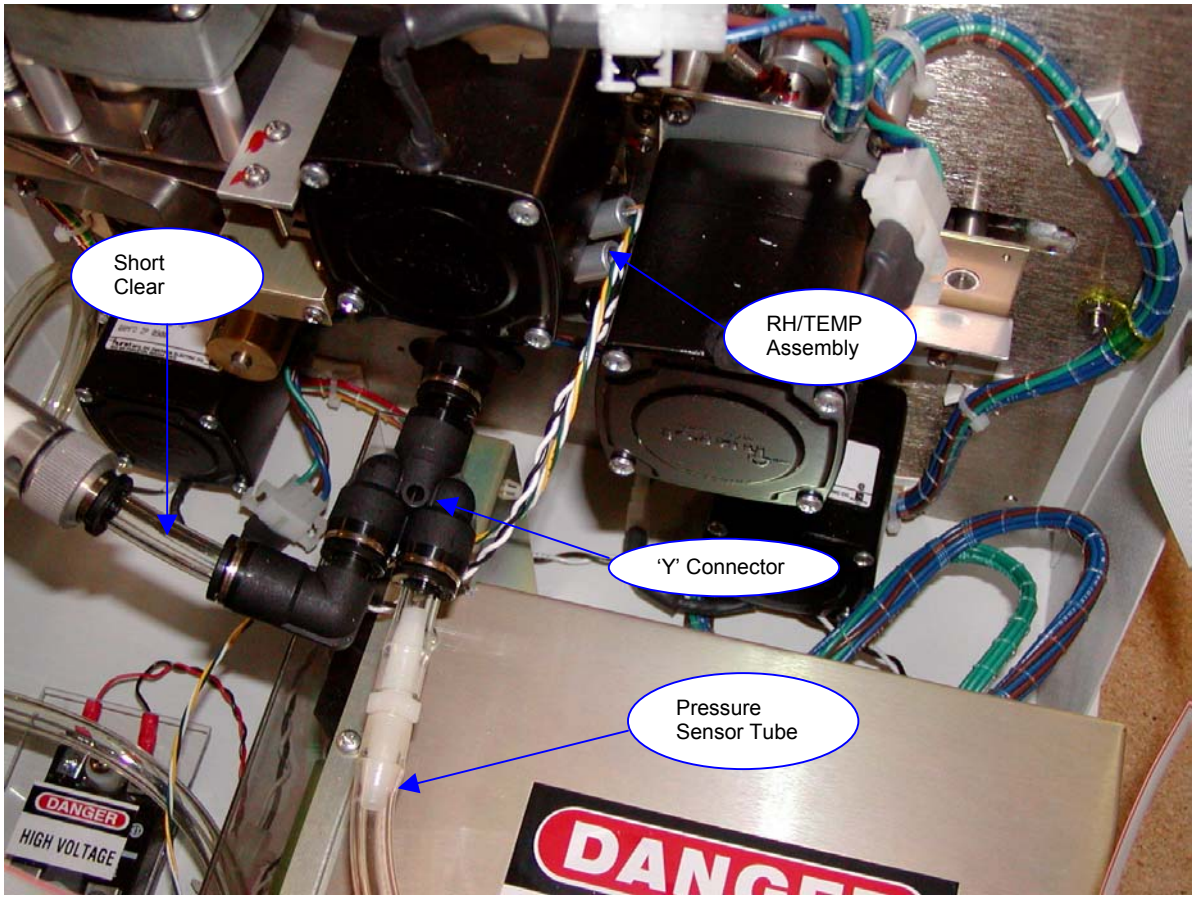
9) Insert the black elbow from the old RH/Temp assembly into the open fitting of the 'Y' connector.

10) Insert one of the two (2) supplied 2 ¾" clear tubing pieces into the black elbow.

11) Remove the old clear tubing pieces from the sintered filter and attach the sintered filter to the newly installed 2 ¾" clear tubing.

12) Attach the remaining new 2 ¾" clear tubing piece to the sintered filter and mass flow meter.

13) Connect the pressure sensor tubing to the plastic tubing/adapter of the 'Y' connector.



Picture 9: New RH/TEMP Assembly Installed

14) Connect the three wire lead of the RH sensor to the connector labeled "J11" on the new circuit board.

15) Connect the two wire lead of the new Temp sensor the connector labeled "J12" on the new circuit board.

2.9 Replace fuses:

1) Where the 120 VAC outlet cord plugs into the BAM-1020, pry open the fuse cover, slide out fuse holder and remove both fuses (1.6 A). **Make sure cord is unplugged from monitor**.

2) Replace with new supplied fuses (3.15 A), slide back holder and replace cover.

2.10 Replace firmware:

1) From rear side of BAM-1020, unscrew two (2) screws and nut that hold EPROM and A/D board assembly (left of meteorological cover).

2) From outside panel of BAM-1020 near other side of the meteorological cover, remove the other two screws to EPROM and A/D board assembly.

3) Remove firmware from EPROM board with IC extraction too provided (if necessary, a small screwdriver can substitute for IC extraction tool). Observe standard static charge dissipation precautions by using supplied grounding strap.

4) Install new EPROM into EPROM board. **Orientation of EPROM is critical**. Use supplied grounding strap.

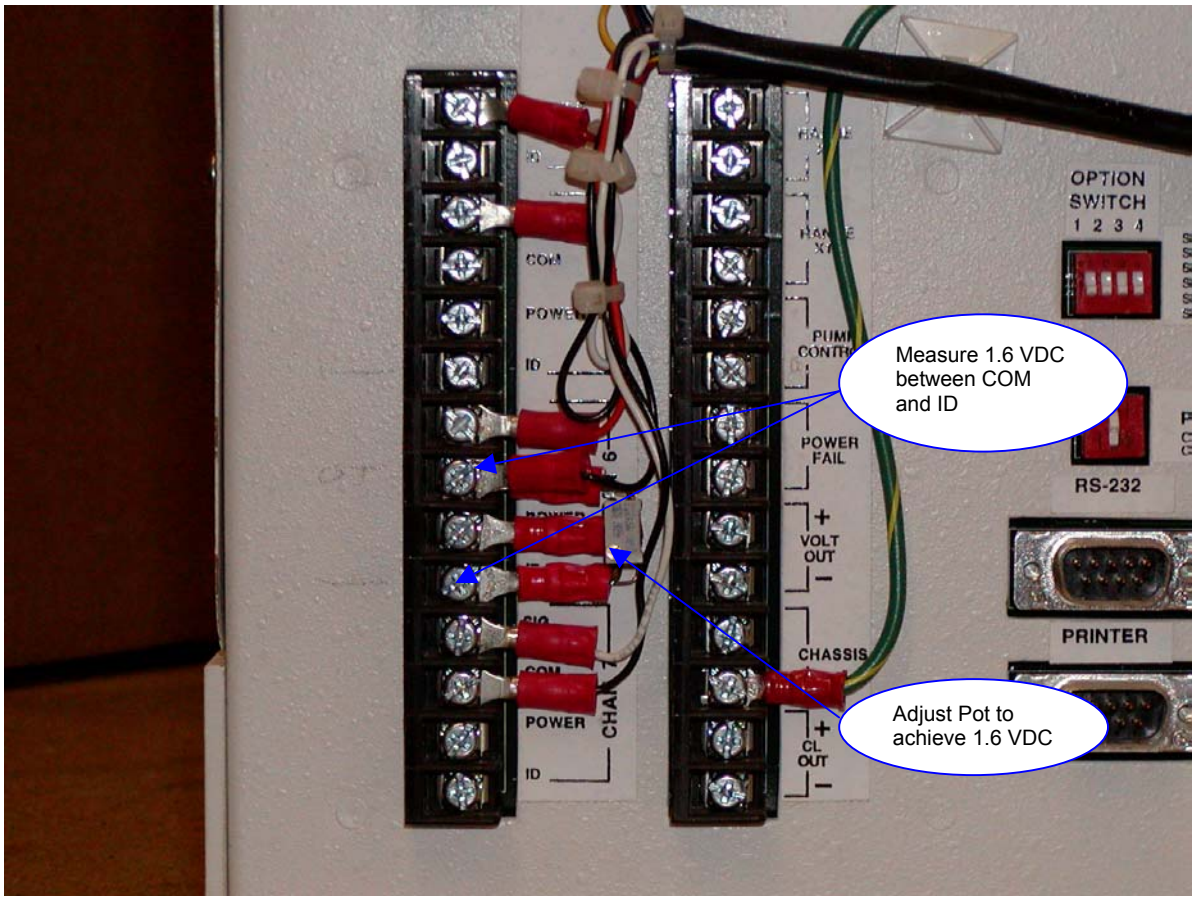
5) Reattach EPROM and D/A card assembly to BAM-1020 chassis.

6) Re-install BAM-1020 cover.

2.11 Install voltage divider:

1) Install the voltage divider to channel six (6) located on the left lower side of the rear chassis panel. When positioned correctly, the potentiometer of the voltage divider is closest to the upper most connector of the voltage divider. The voltage divider is attached to the “COM”, “POWER” and “ID” of channel six (6).

2) Measure the DC voltage on channel six (6) across the “COM” and “ID” terminal. This voltage should equal or be adjusted to 1.6 VDC. Adjust voltage by turning potentiometer on voltage divider.



Picture 10: Voltage Divider Check/Adjust

2.12) Install Inlet Smart Heater:

1) Slide the BAM-1020 end of the inlet tube through Smart Heater. Cord should exit bottom Smart Heater.

2) Install inlet tube into top of BAM-1020.

3) With supplied allen wrench, tighten Smart Heater to the inlet tube approximately 2” above the top of the BAM-1020 (about the thickness of two fingers).

4) Attach Smart Heater cable to plug on rear BAM-1020 panel.

5) Install heater insulation.

3.0 CONFIGURATION OF BAM-1020 SETTINGS

3.1 Setup/Sensor - Channel 6 Configure:

1) On front door panel, press the "**SETUP**" soft key.

2) Using arrow keys, move cursor to the word 'SENSOR' and press the "**SELECT**" soft key.

3) Arrow up to channel six (6) and change setting of ID from 'MANUAL' to 'AUTO ID'.

4) Press "**SAVE**" soft key.

5) Press "**EXIT**" soft key.

3.2 Setup/Calibrate - Heater Configure:

1) Configure Heater to Automatic by pressing the "**SETUP**" soft key.

2) Using the arrow keys, move the cursor downward to the word 'CALIBRATE' and press the "**SELECT**" soft key.

3) Using arrow keys, change 'Heater Control' from 'MANUAL' to 'AUTO'.

4) Press the "**SAVE**" soft key.

5) Press the "**EXIT**" soft key.

3.3 Setup/Heater Configure Settings:

1) Configure BAM-1020 Smart Heater settings by pressing the "**SETUP**" soft key.

2) Using the arrow keys, move the cursor down to the word 'HEATER' and press the "**SELECT**" soft key.

3) Using the arrow keys, configure the to the following:

RH Control:	YES	
RH Setpoint:	45%	
Datalog RH:	YES	(Chan 4)
Delta -T Control:	NO	
Delta - T Setpoint:	99C	
Datalog Delta - T:	YES	(Chan 5)

4) Press the "**SAVE**" soft key.

5) Press the "**EXIT**" soft key.

4.0 TROUBLESHOOTING

Symptom	Possible cause	Suggestion
RH or Delta - T does not appear SETUP/HEATER menu.	Voltage setting on voltage divider not not correct.	Check voltage across COM and ID terminals on channel 6 (1.6 VDC) and adjust if needed.
	Sensor channel 6 not configured to 'AUTO ID'.	Change sensor channel 6 from 'MANUAL' to 'AUTO ID'.
	Sensor channel 5 not configured to 'AUTO ID'.	Change sensor channel 5 from 'MANUAL' to 'AUTO ID'.
When powered up after New firmware change, date and time display contains too many digits.	Wrong version of firmware installed.	There are two versions of BAM-1020 2.55 firmware supplied in upgrade kit. Determine which version is currently installed (labeled on firmware) and re-install other version.